

CLAIMS

What is claimed is:

1. A method for controlling a process on a material comprising:
disposing an electromagnetic sensor proximate to a material that has at
5 least one electrical property that varies with the process;
exposing the material to a process condition;
monitoring said electrical property with the electromagnetic sensor;
analyzing the electrical property; and
using the analyzed result to control the process.
- 10 2. The method as claimed in Claim 1 wherein the sensor is a magnetic field sensor.
3. The method as claimed in Claim 2 wherein the sensor is an eddy current sensor.
4. The method as claimed in Claim 2 wherein the sensor is an eddy current sensor
array.
5. The method as claimed in Claim 2 wherein the sensor comprises a giant
15 magnetoresistive sensor.
6. The method as claimed in Claim 1 wherein the sensor is an electric field sensor.
7. The method as claimed in Claim 1 wherein the sensor is mounted to a surface of
the material.
8. The method as claimed in Claim 1 wherein the sensor is scanned over a surface
20 of the material.

9. The method as claimed in Claim 1 wherein the electrical property is magnetic permeability.
10. The method as claimed in Claim 1 wherein the electrical property is electrical conductivity.
- 5 11. The method as claimed in Claim 1 wherein analyzing the electrical property further comprises:
comparing the monitored property with an estimated property.
12. The method as claimed in Claim 1 wherein the process is thermal treatment.
13. The method as claimed in Claim 12 further comprising:
10 monitoring temperature of the material.
14. The method as claimed in Claim 13 wherein analyzing the electrical property further comprises:
comparing the monitored property with an estimated property.
15. The method as claimed in Claim 1 further comprising:
15 exposing the sensor to the process condition of the material.
16. The method as claimed in Claim 1 further comprising:
exposing the sensor to a different process condition than the material.
17. The method as claimed in Claim 16 further comprising:
placing an intermediate material layer between the sensor and the
20 material.

18. The method as claimed in Claim 1 further comprising:
monitoring at least one additional property.
19. The method as claimed in Claim 18 wherein the at least one additional property
is sensor lift-off.
- 5 20. The method as claimed in Claim 1 further comprising:
measuring the property at multiple frequencies.
21. The method as claimed in Claim 1 wherein the process is fatigue.
22. The method as claimed in Claim 1 wherein the process condition is damage.
23. A method for calibrating a sensor comprising:
10 disposing an electromagnetic sensor proximate to a material;
exposing the material to a process condition, at least one electrical
property of the material varying with the process;
measuring sensor response; and
determining a calibration coefficient for the sensor response using a
15 known relationship between the process condition and the electrical property.
24. The method as claimed in Claim 23 wherein the sensor is an eddy current sensor.
25. The method as claimed in Claim 23 wherein the sensor is an eddy current sensor
array.
26. The method as claimed in Claim 23 wherein the electrical property is electrical
20 conductivity.

27. The method as claimed in Claim 23 wherein the process condition is a change in temperature of the material.
28. A method for determining a relationship between process conditions and an electrical property of a material, said method comprising:
- 5 disposing an electromagnetic sensor proximate to the material, the sensor measuring the electrical property of the material;
- exposing the material to a process that affects the electrical property of the material;
- measuring said electrical property for at least two process conditions; and
- 10 using measured values to determine the relationship between the process conditions and the electrical property.
29. The method as claimed in Claim 28 wherein the sensor is an eddy current sensor.
30. The method as claimed in Claim 28 wherein the sensor is an eddy current sensor array.
- 15 31. The method as claimed in Claim 28 wherein the electrical property is electrical conductivity.
32. The method as claimed in Claim 28 wherein the process comprises changing temperature of the material.
33. The method as claimed in Claim 32 wherein the electrical property is electrical conductivity.
- 20 34. The method as claimed in Claim 33 wherein the relationship between the temperature and the conductivity is linear.

35. The method as claimed in Claim 32 wherein measurements used to determine the relationship are performed during an initial heating transient.
36. The method as claimed in Claim 32 further comprising:
controlling the process to minimize divergence of a measured property
5 from a property estimated from said relationship.